The Stimulus of S.S. Wilks to Army Statistics

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ABSTRACT

The stimulus of S.S. Wilks to the scientific community is discussed briefly, followed by a more detailed account of his originating the idea of a service of Army-wide conferences on design of experiments in Army research, development and testing. The Army's rather satisfactory progress in statistical methodology prior to the conference series is discussed, with comments on its limitations and less than ideal direction of procedure. Wilks' apparent perception of the situation, his courage in undertaking a large and difficult task, and his surprisingly large measure of success is discussed. The importance of carrying on the spirit of Wilks is emphasized, and the creation of The Wilks Award, as a measure to that end is mentioned.

ORIGIN OF THE CONFERENCE SERIES

Mr. Chairman, Fellow Conferees, Ladies and Gentlemen, Samuel Stanley Wilks was my very good friend most of his professional life. Whereas I am aware of many of Wilks' dedicated and outstanding services at a national, if not a world level, I prefer to concentrate my remarks on an area of Wilks' career that is close to home to me: the very valuable services that he did voluntarily for the Army. I am sure that others more able than I will cover his broader services as a teacher, both academic and extra curricular; as a research worker, as an organizer, and as a competent and inspiring leader. Frederick Mosteller has presented an excellent outline of Wilks' worldwide work in the April 1964 issue of *The American Statistician*, under the title, "Samuel S.Wilks: Statesman of Statistics." Mosteller's paper should serve as a guide for other papers on Wilks. However, I cannot help observing that although Mosteller's title is justified, I hope that he will forgive me if I observe that Wilks was by his own choice somewhat lacking in the formality associated with statesmanship. Contrary to one's concept of dignity, Sam was "just folks," whether he was talking with a first-rate scientist, a neophyte in Applied Statistics or a man primarily a soldier. He knew and understood people; and, by nature was ever-ready to give any help within his competence to anyone who genuinely needed it. It was in the latter two capacities that I had my entrée to Wilks.

It was over fifteen years after our initial meeting that Wilks made a proposal that has helped much in improving Army organization, doctrine, tactics and weapons; and, at the same time contributed to improving the morale of Army personnel, and to saving time and expense in military research and development.

In late 1954 or early 1955, when I was Assistant Chief of Ordnance for Research and Development, U.S. Army, Wilks proposed that the Army establish a series of Army-wide conferences on design of experiments in Army research, development, and testing. Dr. Frank E. Grubbs, who, under the authority of my office, had chaired an Ordnance symposium on Statistical Methods in 1953 [1], strongly endorsed Wilks' proposal for Army wide conferences, devoted primarily to design of experiments; and, of course, I concurred. The Army Mathematics

Advisory Panel* (later, designated as the Army Mathematics Steering Committee) operated under the Office of Ordnance Research (now Army Research Office-Durham); and consequently the responsibility for the conferences was assigned to that office. Wilks' proposal was made pursuant to a survey made by the Army Mathematics Steering Committee in which they investigated over 30 Army facilities. They found that one of the most frequently mentioned needs expressed by the scientific personnel was for greater knowledge of modern statistical theory of the design and analysis of experiments. The First Conference on Design of Experiments, in Army Research, Development, and Testing was held on October 19-21, 1955 at the Diamond Ordnance Fuze Laboratories and The National Bureau of Standards. Wilks chaired all the conferences up to the present Tenth Conference.

I believe that observing as best we can the time-rate-of-change of the character of these conferences and the concurrent increase of basic understanding of the interrelationships of men, weapons, organization, doctrine, tactics, and research and development, will throw light on the beneficial influence of Wilks on National Defense. I do not mean to infer that all Statistical progress is due to Wilks; but I am sure that much of the progress is due to the spirit of cooperation that he infused, to his influence and to his personal contributions. Similarly, I believe that the history of Wilks in this relatively small sub-field of his very active life is a close parallel to the fruitfulness of his activity in other fields to which he devoted far more time. Let us, then, observe the status of Army statistics up to 1953; trace, at least approximately, the conferences on Design of Experiments in Army Research, Development and Testing; and observe the present-day status of Army statistics.

Incidentally, the Army was neither without statistical sophistication in 1953, nor is its knowledge optimum today.

SUMMARY OF ARMY STATISTICAL PROGRESS, BETWEEN WORLD WAR I AND II

Historically, the application of probability theory to the dispersion of shots on a target appears to be about the only Army use of Statistics, prior to World War I. There was a jump in mathematical sophistication during World War I, due to A.A. Bennett [3], Fowler [4], Moulton [5], and others in connection with progress in applying statistics to Ballistic problems. Between World Wars I and II, Kent, Dederick, McShane and others developed further applications of Statistics in connection with Ballistics. The staff of the Bell Telephone Laboratories, especially Dr. Walter A. Shewhart and Harold F. Dodge, was most fruitful in the discovery of Statistical techniques, and the Army was a shameless plagiarist in adapting them to its problems. Shewhart's work [6] led to the Army's first full-scale industrial use of Statistical Quality Control in manufacture at Picatinny Arsenal, New Jersey, which also was certainly one of the first few of such uses in the world. The Army Ammunition Surveillance [7] (Stockpile Reliability) System (circa 1939) was based largely on what was very recent work at that time. The Dodge-Romig Sampling Tables, not yet in book form [8], appeared just in time for use for ammunition

* The Army Mathematics Advisory Panel, of which Wilks was a member, was operated by the Ordnance Corps for the Office of the Chief of Research and Development, U.S. Army. I am indebted to Colonel P. N. Gillon (Ret.), who was both the Commanding Officer of the Office of Ordnance Research (Durham) and the very able Chairman of the Army Mathematics Advisory Panel for the clear, curt minutes and records that he left, and especially for reference [2].

inspection and acceptance tests in World War II. During the period shortly before World War II, the Army felt a bit smug about its statistical competence.

ARMY STATISTICAL PROGRESS DURING WORLD WAR II

World War II saw great progress in the military use of Statistics, due primarily to the availability to the war effort of men of competence. The National Defense Research Council (later, Office of Scientific Research and Development), the staff of the BRL, and, to a lesser extent, the staffs of Ordnance Arsenals, acquired many Mathematicians and Statisticians of competence. Procedures for specifications of materiel, sampling, testing and interpretation of data (both planned data and the salvaging of unplanned data) were greatly improved. Indeed, Operations Research was being born even then. The Army* was not unmindful of the possible adaptation of any new Statistical "tool" to its work.

In addition to the above uses of Statistical Methods a substantial progress was made by the Army during World War II of which there is little or no record. Many new techniques such as Sequential Sampling and Reliability were actually used in the Army, at least in an empirical way, before they were later designated by appropriate specific names. Of course, needed theory was not worked out in a formal way at that time. For example, the formal presentation of sequential sampling had to await the work of Dr. Abraham Wald, which was not published in book form until 1947 [9].

ARMY STATISTICAL PROGRESS, WORLD WAR II – 1953

After World War II, progress continued, although its rate was diminished due both to decrease in staff and to loss of some of the more competent people. Apparently, experiments that involved Factorial Designs were the first instances of full use of Experimental Designs in the Army. Factorial designs were used at the Ballistic Research Laboratories in the study of armor plate (1946-47)+, in the mammoth experiment on Aircraft Vulnerability (1946-50)+, and even on Project Stalk (a tank-fire control study under field conditions)+ circa 1953. In 1953-1954 Reliability [10], in its present day sense, was used by Ordnance Research and Development, in a full-scale organizational and technical way, as a means of rescuing the Country's first operational guided missile, the NIKE, from a serious threat of failure.

With this rather glowing account of Army progress and status, one might well question wherein was the Army laggard, and where was the failure or potential threat of failure? What great work was there left to be done by the series of conferences on design of experiments under Wilks? I shall show that a very great deal was wrong with the Army's use (or lack of use) of statistical methods; that the task of righting the wrong was formidable, both in magnitude and in potential obstacles; and that astonishing progress has been made on the task during the nine years of the conference.

From the survey of the 30 Army facilities, Wilks must have understood rather well what the Army needed, and have understood also the need for newly organized and sustained effort to

* References to the Army do not imply that the Navy and Air Force did not also make progress.
+ Ballistic Research Laboratories Publications.

supply the need. His skill as a teacher must have fortified him from fear of failure in undertaking to change the mode of operation of a large segment of the Army.

WHAT WAS WRONG

Let us observe that the origin, growth, and use of Statistical Methods in the Army was not only unplanned, but actually tended to progress in the least advantageous direction, i.e., from endpoint to origin, rather than from origin to end. Roughly speaking, we can regard the military regime as consisting of the following steps or stages: doctrine, tactics, organization, selection of equipment, fabrication of equipment, test of equipment, and use of equipment. Logically, a powerful medium for the improvement of a stage should be first applied to the preceding stage or stages to which it is applicable. For example, a big improvement in use of equipment (e.g., accuracy of ammunition) loses much of its potentially beneficial effect if either the tactics, organization or weapons system is poor.

Contrary to the above observation, the earliest use of probability theory by the Army was for use of equipment, viz., the adjustment of artillery fire. The use of techniques based on the Gaussian Distribution, or Normal Probability Law, in connection with artillery fire probably is exceeded in antiquity only by the use of elementary probability theory in connection with games of chance [11].

Decades elapsed before the next major step. In 1936, the Army began to use Statistical Quality Control in the manufacture of equipment, viz., the production of ammunition at Picatinny Arsenal, Dover, New Jersey. Kindred techniques such as sampling theory and statistical methods for analyzing data soon spread to improve specifications, inspections, and acceptance tests.

During World War II almost all fabrication of military equipment was better, cheaper, and quicker, due largely to these techniques. During World War II, one strange reversal occurred in the inverse order of progress. Operations Research was born out of military sponsorship and was actually used to a limited degree by the staffs of high military planners in connection with the planning of the operations of large combat forces.

After World War II, it began to be more and more realized that since Statistical Methods improved the quality of equipment and reduced costs it would be a good idea to use similar techniques with the research, developing, and testing in connection with new designs of equipment, thereby making better and more useful equipment designs at the outset. Except for the invention of Reliability, which was a distinct child of necessity, this is just about where Wilks came in.

WILKS' TASK

When Wilks toured the 30 Army installations with the Army Mathematics Advisory Panel, it was he who articulated, "the most frequently mentioned needs expressed by the scientific personnel were for greater knowledge of modern statistical theory of the design and analyses of experiments." Thus, it is clear that Wilks recognized at least a major part of what

was wrong with the Army, i.e., insufficient use of Design of Experiments in Research, Development, and Testing.*

Certainly Wilks was not the first person to recognize the fact that an improvement in the early stages of the Army regime, i.e., doctrine, tactics, organization, etc., has greater leverage power than an improvement in later stages such as selection of equipment, fabrication, and use. The trend toward "up-stream" improvement began long before he appeared on the scene, and ranged from such measures as advocacy of industrial preparedness, as an important measure towards preserving the peace, to various stratagems for introducing sophistication in the upper stages of the Army's evolutionary process. Many persons deplored the fact that traditionally we had been forced to begin wars with the weapons left over from the previous war. Army Ordnance began to take measures against this ill shortly after World War I, and the then infant Army Ordnance Association (now the American Ordnance Association) lent a patriotic and helping hand, pursuant to its slogan advocating industrial preparedness as an insurance against war, i.e., a large production capacity should exist to meet a war demand for munitions of the latest designs. Army Ordnance realized that it must have an eye to the future and an ear to the ground regarding the plans and needs of the combat soldier, and therefore sent selected Ordnance Officers to the Army Schools ranging from the Command and General Staff College to the National War College to give them a close understanding of the combat soldier. Liaison officers from the combat arms were assigned to Aberdeen Proving Ground, Maryland, to assist in the realization of combat viewpoints, and in the development tests of materiel. Shortly after World War II, a number of persons, including some Ordnance, advocated the establishment of a scientific staff at Headquarters, Army Field Forces, Fort Monroe, Virginia, to assist in analyzing Army needs and in stating needs for new materiel in valid form. Such a group was partially formed and existed for a year or two+. However, it was Wilks who undertook systematically the task of greatly accelerating the spread of powerful and useful statistical techniques to the upper echelons of the Army regime, where the improvements that they enhanced would have the greatest leverage power.

Even if Wilks recognized the full nature of the job that he was doing, certainly, he did not have opportunity to finish the job. Much remains to be done. The real point in this discourse is the breadth and extent of the progress made in the nine years of Wilks' kindly and sympathetic leadership, effective persuasion, and his engendering of mutual cooperation and helpfulness between men of competence with whom he dealt. Let us try to note the progress, before any attempt to assess the remaining task.

ASSESSING THE PROGRESS

I hope that by the foregoing discussion I have led no one to believe that I have an objective method of measuring the progress of use of statistical methods in the Army during the 1955-63 period. I might say that the measuring of progress in a field of science or engineering is perhaps one degree more difficult than measuring the quantity and quality of output of research

* The Army was not new to Wilks. In 1948 he was awarded a Joint Army-Navy Certificate of Merit for his war-time contributions to anti-submarine warfare and the solution of convoy problems.

+ Later, a permanent group was formed.

by laboratory; and whereas many have tried to do this, I know of no one who has really succeeded. The cold statistical facts are briefly these:

All the design of experiments conferences were for three days each, held in October or November, and conducted at a number of Army R&D establishments.

The number of registrants or conferees was always of the order of 200. Attendance was by invitation and the number of invitations was undoubtedly conditioned by the available accommodations.

The number of papers presented at each conference was of the order of 30. This appears to be about the number of papers that can be presented in a three-day conference.

All conferences were of a three-part character: invited papers by distinguished Statisticians, technical sessions in which there were discussions of recent accomplished work, and clinical sessions in which work in progress was discussed from the viewpoint of inviting advice and criticism.

It thus appears that based on documental evidence the progress of the conferences can be judged only by the kinds of scientific and technical fields covered by the papers and by the inherent quality of the papers.

CHARACTER OF PAPERS PRESENTED

By and large, the place at which the conference was held had a strong influence on the character of the papers presented. This is undoubtedly due to the fact that the program committee gave some degree of precedence to the host institution, e.g., more papers bearing on the field of medicine were presented at the Eighth conference held at Walter Reed Medical Center than at other conferences. However, in the statistical fields there was a constantly increasing emphasis over the nine years on the more sophisticated phases of design of experiments, screening theory, simulation stratagems, reliability, and techniques for evaluation of experiments. It is thus apparent that expertise on the part of the participants increased and also evident that the use of statistical experts in various fields of Army activities was increased both in number of experts and in variety of fields of activity.

Whereas, at the beginning of the conferences papers centered largely around items of Ordnance materiel, as the conference proceeded the subject matter of the conferences expanded to include more emphasis on systems analysis. Similarly, with the penetration of statistical methods into new fields of activity, more papers were devoted to other than Ordnance equipment. With the broader use of statistical designs, papers appeared on the relation of equipment to organization, and to new theoretical developments having immediate application in Army use.

A further change in the character of the papers is the noticeable effect of learning to do by doing. It is apparent that whereas designed experiments gave greatly improved results, the same experiments also showed deficiencies in understanding what one's work was really about.

For example, biases in results could be detected that were readily attributable to repeated use of the same personnel over the same terrain. Command exercises had to be altered and new stratagems employed (such as randomization techniques) to screen out the biases which passed unnoticed when experiments were of less sophisticated character. In fact it was precisely the acquirement of such evidence that convinced even non-statisticians that there was need for more movement "up-stream." This was a very fortunate circumstance because it drew military commanders into participation in the planning of the experiments and resulted in a constant movement of the sphere of activity of statisticians into the domain of persons who were concerned with policy, tactics, and doctrine. Thus, non-statisticians saw the gains made through experiments in which they, themselves, participated.

It is quite one thing to make a presentation on the efficacy of a technique and quite another thing to convince the hearer that the use of the technique is important to his job. Successful experiments in which on himself has participated (although a step-wise process) are an effective method convincing one of the value of the methods used. By way of contrast, I believe that it would be quite impossible to suddenly inject into the military service (or into any other organizational sphere, for that matter) the concept and attitude which is expressed by the following quotation taken from a Combat Developments Experimentation Center (CDEC) pamphlet:

> "The ability of the Army to carry out its goals in the future depends upon the success it has in achieving its combat development goals today … of developing future concepts, doctrine, tactics, and techniques, and providing requirements for weapons, equipment, and appropriate organizations."

It is indeed heartening to read such a quotation. This Experimentation Center has an area of over a quarter of a million acres, a brigade of troops, a contract with Stanford Research Institute for Statistical Support, a variety of sophisticated equipment, including facilities for computer simulation of field experiments. Nevertheless, we know well that the tasks expressed in the quotation are only beginning and that only the first fruits have yet been achieved. From the foregoing example of CDEC we can infer (a) that the advance of Statistical Methods in the Army, during the past nine years have been great, and (b) that the remaining part of the task, i.e., achieving the full nature of the job that Wilks undertook is still a large one.

WILKS' METHODOLOGY

If we hope to carry on in substantial measure the task that lies ahead we should take a good look at Wilks' methods. Wilks was a scientist for the sake of science, but he was also a realist and wished to see the practical results of applied science come to full fruition. This is a rare combination of qualities.[*] Despite his many high scientific achievements and the respect in which he was held by his colleagues, he never assumed an authoritative position. On no

[*] In writing for the journal of the Royal Statistical Society, July, 1964, the noted British Statistician, E.S. Pearson says, "… it is hard to think of any mathematical statistician of the past 30 years who combined to a greater extent an excellence in the field of theory with a power of inspiring confidence in government agencies, national research institutions, and educational authorities, as a wise counselor in practical affairs."

occasion did he attempt to do a whole job himself to the exclusion of others. On the contrary, he always invited the cooperation of every person who could contribute substantially to getting the job done. He could organize and delegate without being obvious about it. In this way he secured the enthusiastic support of the men around him. If anything, he was more the servant of others than one demanding services. He had confidence in himself, but he also inspired confidence in others that led them to venture to cooperate, to work with him, and to work together; and the work became an interesting enterprise to the point of preoccupation. In closing, I would like to give a brief example of how the spirit of Sam Wilks worked towards getting things done whether they were large or small.

AN EXAMPLE OF WILKS' WORK

About a year and a half ago, a gentleman in Georgia, a former member of the war-time team at The Franklin Institute, who is intensely interested in small arms fire asked several statisticians including Wilks some questions about the inter-relations of various measurements of central tendency and dispersion of shots on small arms targets, although he did not express it in these terms. In order to answer his questions, one needed to know the probability density distributions of several statistical measures whose distributions were unknown. These questions set off a kind of chain reaction. It was possible that answers to the small arms problem could well be answers to other, and probably more important, problems. Scientific men of good will, infused by the spirit of cooperation and scientific inquiry contributed what they knew to the general problem; but it became evident that a complete answer could be achieved only by some research that would add a modicum of knowledge to our existing store. Perhaps the most important contributions came (later) from Wilks, Grubbs, and one or two other colleagues in connection with their work on the analysis of tracking data on firings of long range missiles at the Atlantic Missile Range. The work turned out to be so important that it has been carefully written up by Grubbs in a forthcoming monograph. First, he was willing to lend his powers to anything that appeared to be a valid scientific enterprise; second, he had a keen perception of what is fundamentally important even though the context in which it was presented made it appear somewhat of casual interest if not unimportant; third, he could engender the spirit of true scientific inquiry into his colleagues; fourth, he could bring a matter to a crux so as to make it a permanent addition to the useful knowledge of mankind.

THE WILKS' AWARD

It is important that the spirit of Sam Wilks be carried on, both for an unselfish reason and a selfish reason. Our first reason is that of honoring his memory in gratitude for what he had done for us. The second and selfish reason is that carrying on the spirit of his work will contribute much to advancing the solutions for the great task that he loved and to which he devoted himself. We shall never achieve the task in full; but each solution or partial solution will contribute to the improvement of the military posture and safety of our Country. I am sure that Sam would approve this second motive. Through the generosity of Mr. Philip G. Rust of Thomasville, Georgia, and the good offices of the American Statistical Association, it appears that a means has been found of achieving, at least in part, both of the above purposes. An award will be created which by its character will help to carry on the stimulus of Wilks to Army Statistics.

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THE WILKS AWARD

Introduction of Mr. Donald C. Riley by Major General Leslie E. Simon

Mr. Chairman, Fellow Conferees, Ladies and Gentlemen, what the next two speakers have to say is so closely associated with my discourse on Wilks that I have been designated to introduce them.

As I implied at the end of my talk, the establishment of the Wilks Award was a tri-partite undertaking, and involved: the Army as principal beneficiary, the American Statistical Association as the bearer of the burden of administration, and Mr. Philip G. Rust who endowed the award. Secretary Hawkins has personally expressed to the ASA his gratitude for its competent and patriotic services.

Mr. Donald C. Riley, Secretary-Treasurer and Executive Director of the American Statistical Association has rendered invaluable assistance in getting swift solutions to procedural problems he has been so kind as to agree to indicate to you the duties and obligations of the ASA in carrying out the Wilks Award, and he will also announce the recipient of the initial Wilks award. Don Riley!

INITIAL WILKS AWARD PRESENTED TO DR. FRANK E. GRUBBS

Donald C. Riley, Executive Director, American Statistical Association

Many members of the American Statistical Association, as well as I, are glad to be present at this, the Tenth Annual Design of Experiments Conference. This is a very special occasion and the American Statistical Association is glad to participate during a uniquely auspicious time in its long history. This year is the 125th Anniversary of the establishment of the American Statistical Association which recent research at Stanford has found to be the second oldest national professional society in the United States.

The American Statistical Association has always worked closely, although usually quite informally, with agencies of the Federal Government. For example, during the year it was founded, 1839, it began to press for the improvement of decennial censuses and its representatives played a major part in the design of four of the six schedules for the 1850 Census. As statistics and statistical methodology proliferated vastly since that time, almost all areas of research have felt their impact. Certainly the whole area of design of experiments has had the closest association with statistics. The annual Design of Experiments Conference has become an institution. General Simon has reminded you of the close association of Professor Samuel S. Wilks with this Conference. Most of you know that relationship by heart. Sam lent his aid readily, unstintingly, and effectively in many areas. This was part of the genius of the man.

I should note also that Wilks was the President of the American Statistical Association in 1950 and that he had always done much for the Association. He also helped to carry on in another area the close relation between the Association and the Federal Government. Just the day before he died he participated as a member of the Advisory Committee on Statistical Policy

to the Office of Statistical Standards in the Bureau of the Budget. The Office of Statistical Standards requires consultation from time to time at a high level in its work as the central statistical coordinating body of the Federal Government. This Advisory Committee consists largely of former ASA Presidents and Wilks was one of its "founding fathers."

As mentioned in General Simon's address, the ASA has recently had the opportunity to be of further service. By joint agreement between representatives of the Army, Mr. Philip G. Rust, and the ASA, the Samuel S. Wilks Award has been established. The Award will consist of a medal and an honorarium. The ASA has accepted the obligation of administering the Award in accordance with guidance and criteria which are consonant with law and with the wishes of Army representatives, Mr. Rust, and the ASA.

Annually, ASA has agreed that an appropriate committee be selected (or appointed) to select the awardee, based on the criterion that he is a person whom the committee regards as deserving of the award, based primarily on his contribution (either recent or past) to the advancement of scientific or technical knowledge, ingenious application of existing knowledge, or successful activity in the fostering of cooperative scientific efforts which have only coincidentally benefited the Army. The award shall be made with the intent of recognizing the personal and intellectual accomplishments of the individual and shall not be given with the intent of supplementing the individual's salary, providing him with compensation, or advancing the interests of the donor or trustee of the endowment.

The American Statistical Association has been asked to invest the funds so generously turned over to it for this purpose and I am sure that its Board of Directors, which has given its wholehearted approval, feels honored in being asked to join in honoring Sam Wilks. ASA will need to consult very closely with those of you who have helped to develop the annual Design of Experiments Conferences, in the selection of an Annual Sam Wilks Award Committee. I believe that Dr. Albert H. Bowker, the President of the American Statistical Association this year, will be able to announce this Committee shortly.

As executive Director of the ASA, I have the honor to announce that Dr. Frank E. Grubbs of the Army's Ballistic Research Laboratories has been selected to receive the "initial," <u>not</u> <u>the first</u>, Samuel S. Wilks Award. As is not unusual in the initial award of an honor, Dr. Grubbs was selected not by the process governing the first and subsequent recipients, but rather by unanimous agreement of those concerned with the establishment of the Award. He is so selected because of his close working relationship with Wilks, and especially because of his contributions along with Wilks to solutions and clarification of simple measures of dispersion, which are deemed useful to riflemen, ballisticians, and statisticians in general.

I have no medal to present to Dr. Grubbs, because the medal has not yet been struck; but it will be presented at the earliest appropriate opportunity, after it is available.

Incidentally, I will not be able to attend the banquet here tomorrow evening because I agreed long ago to attend the inauguration ceremonies in New York of Dr. Bowker as Chancellor of the combined Universities of the City of New York which was organized a few years ago.

The American Statistical Association will want to continue to advise closely with the Conference and will be glad to ask its auditor to render a brief auditing report each year if this seems satisfactory to those who have been so close to Sam Wilks, General Simon, and especially Mr. Philip G. Rust, who has been so generous and public spirited in making the award possible. I should like to join in thanking Mr. Rust most profoundly.

INTRODUCTION OF MR. PHILIP G. RUST BY MAJOR GENERAL LESLIE E. SIMON

Mr. Chairman, Fellow Conferees and Ladies and Gentlemen.

We now come to the third and last speaker in this phase of our honoring Sam Wilks, Mr. Philip G. Rust of Winnstead Plantation, Thomasville, Georgia. Mr. Rust is a very modest man, and more adept at understatement than a typical Britisher. It was only under pressure personally exerted by Secretary Hawkins that we succeeded, first, in overcoming his insistence that he remain anonymous, second, in getting him to attend this conference, and third, in persuading him to present the honorarium to the initial recipient of the Wilks Award, Dr. Grubbs.

Mr. Rust purports to be practically innocent of theoretical and applied statistics; but if under pressure, he can cite statistical literature by page and paragraph showing each historical advance in statistical measures of dispersion; he professes no close association with science and engineering, but I find that he was not only a research chemist for over ten years, but also returned to science and engineering during World War II; he lays claim only to being a Georgia farmer, but he has contributed to ASA the funds necessary to establish the award commemorating his old friend, Sam Wilks, contributing to the welfare of the military services, and fostering science in general.

With these cautionary remarks, I deem it a privilege and an honor to introduce Mr. Philip G. Rust.

THE CONCEPTION OF THE WILKS AWARD

Philip G. Rust, Winnstead Plantation, Thomasville, Georgia

Mr. Chairman and members of the audience you have heard a most informative talk by General Simon on “The Stimulus of S.S. Wilks to Army Statistics.” Then, on Thursday, we may look forward to Dr. Eisenhart’s “Sam Wilks as I Remember Him.”

In view of the newly established Association’s Wilks Award, concisely described to you by Mr. Donald C. Riley, the Executive Director of the American Statistical Association, it is appropriate that I briefly discuss the conception of this award.

Back in the dark days of 1944, Dr. Wilks and I were headed north from Washington, by train, he to Princeton and I to my home in Wilmington. At the time, I was at The Franklin Institute, working on .50 calibre barrel erosion, and also as the unofficial translator of pertinent technical works. In passing, I would state that the Institute work was less statistical than of the ear drum rupturing variety.

On this train trip, I happened to mention, that for years, my spare time has been devoted to certain statistical measures of shots on a target. After telling Dr. Wilks about the firing of hundreds of .22 calibre targets, from rest; to get an empirical measure of the distribution of "extreme spread", he asked if I had started any theoretical work on the subject. (Incidentally, "extreme spread" is defined as the separation distance of the two widest apart shots.) His interest increased when it was mentioned that I had made a start by generating a few hundred artificial targets by using pairs of random numbers in the well-known bi-variate circular distribution. Equal likelihood of angular distribution was assumed, with no systematic errors.

The shots were laboriously plotted on cross section paper, and the extreme spread and other parameters examined. It is of interest to note that the fired targets and the plotted ones are extremely close.

About this time my traveling companion suggested that he disembark at Wilmington, also. I had the feeling that he wanted to explore the application of these data to other, more vital matters. He stated that he had an exceptional graduate student who might be given the job of finding the true distribution of "extreme spread."

Eight or ten years went by, and our contacts were largely by phone. He assured me that he was still interested, and working on target problems, but that as yet, this distribution had not been discovered. The possibility of Monte Carlo methods on a to-be-acquired computer were discussed. Then on 10 August 1963, I received a long-hand letter saying that a 7090 computer was at hand, busily working on related matters.

While waiting for promised data from Dr. Wilks, I approached General Simon about the subject. He later discussed it with Dr. Frank Grubbs of Aberdeen, who subsequently brought forth an extremely useful manuscript, soon to be published.

Finally, on Dr. Wilks' 1963 Christmas card, he stated that the target problem was tied in with tracking work on the Atlantic Missile Range.

General Simon, with his very orderly mind, and sense of the fitting, then suggested the idea of the annual A.S.A. Wilks Award. This idea was greeted enthusiastically by all concerned.

What, then could be more fitting, than that Dr. Frank E. Grubbs should be the recipient of the initial award.

And now, it gives me great pleasure to hand Dr. Grubbs the initial honorarium and the assurance of its accompanying medal on its completion.